Astronomy

ES-2 The student will demonstrate an understanding of the structure and properties of the universe.

ES-2.8 Explain how gravity and motion affect the formation and shapes of galaxies (including the Milky Way).
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/future knowledge: Galaxies and their shapes were introduced in 8th grade (3-3.8). In this course understanding of the factors that influence the formation and the shapes of those galaxies are developed.

It is essential for students to know that the major components of the universe are galaxies consisting of groups of stars bound together by gravitational attraction. Galaxy formation theory is just beginning to be developed. The present view of galaxy formation holds that large systems were build up from smaller ones through collisions and mergers. Galaxies are classified by shape into three main types – spiral (normal and barred), elliptical, and irregular.

Spiral Galaxies*:*
- Contain a flattened galactic disk in which the spiral arms are found, a central galactic bulge, and a halo of faint, old stars.
- The galaxy contains both young and old stars along with gas and dust that continue formation of new stars.
- The Milky Way galaxy that contains our solar system is a spiral galaxy; it looks milky or hazy because the stars are to close together for human eyes to see them individually.
- The gas and stars in the disk move in circular orbits around the galactic center.

Elliptical Galaxies*:*
- Have no galactic disk; stars are distributed throughout the nearly spherical to very flattened shape.
- There are no obvious structures other than a dense central nucleus/
- The galaxy contains only old stars along with little or no gas and dust for new star formation.
- The stars in the galaxy move in random orbits.

Irregular Galaxies*:*
- Have no obvious structure; some have an explosive appearance.
- The galaxy contains both young and old stars with ongoing star formation.
- The gas and stars in the disk move in very irregular orbits.

It is not essential for students to know the names of specific galaxies other than the Milky Way or the further classifications within the main three. Distances between galaxies, galaxy clusters, or properties of galaxies are also not essential content for this indicator.

Assessment Guidelines:
The objective of this indicator is to *explain* the formation of galaxies and shapes of galaxies based on gravity and motion; therefore, the primary focus of assessment should be to develop cause and effect models of these concepts.
In addition to explain appropriate assessments may require students to:
- *illustrate* the shapes of galaxies;
- *compare* the three types of galaxies by description, star formation, and movement of galaxy gas and dust; or
- *recognize* the basic components of each type of galaxy.